THE BIRTH-RATE IN MASSACHUSETTS, 1850-90.

FOR a statistical study of births the exact meaning of birth-rate must first be agreed upon. The birth-rate in its usual sense means the ratio between the number of people living in the middle of a year and the number of births occurring among them in the course of that year. It is ordinarily stated in terms of so many births for each thousand of the total population. But large classes of the population are rendered by youth or age physically incapable of contributing to its births; and other large classes, whose age is no barrier, are unlikely to do so because they have not formed a marriage relation. Hence the total population is an unsatisfactory basis of comparison. The best method would be to divide the births into the two classes of legitimate and illegitimate, and to compare the former with the number of married couples, both members of which were of reproductive age, and the latter with the number of unmarried persons of reproductive age. But the limits of this age among men are more variable and indeterminate than among women. Hence it has become customary to compare the births of each class with the number of married or of unmarried women of reproductive age. While this assumes that each such married woman is married to a man of reproductive age, the error arising in consequence probably is negligibly small.

The crude birth-rate, then, is the number of births annually to each thousand of total population. The accurate legitimate birth-rate is the number of legitimate births to each one thousand married women of reproductive age. The accurate illegitimate birth-rate is the number of illegitimate births to each one thousand unmarried women of

reproductive age. The limits of reproductive age among women are assumed in this paper to be fifteen and fifty.

For statistical purposes a birth may be defined as the delivery of a viable child. Practice differs somewhat in determining what shall constitute a still-birth. A child of viable age that is dead before or at birth is uniformly considered to be still-born; but in some countries a child that dies within one, two, or three days after birth is counted among the still-born. From the statistical point of view the still-born are generally considered apart, and are not classed either as births or as deaths.

The study of statistics of births divides itself into two main branches. We may study, first, the relations of various categories of births to each other; and, secondly, the relations of births to other phenomena, as marriage, death, prosperity. Under the first head, births may be classed as male or female, legitimate or illegitimate, living or still-born. All these distinctions are made in the registration reports of Massachusetts, upon which this study is based. It will be convenient to consider, first, some of the facts as to the cross-divisions among births, and to proceed then to the general birth-rate.

The normal excess of male births over female, first pointed out by Graunt in 1662,* and more completely demonstrated by Süssmilch in 1741,† appears again in Massachusetts. Süssmilch found the excess of boys to be as 21 to 20. Later investigation has shown that the ratio varies somewhat in different countries. But, in general, the range is slight; and most countries would be included in a range extending from 104 to 106 boys (both figures included) to 100 girls.‡ Massachusetts forms no exception. Of the total number of living births regis-

* *Observations on the Bills of Mortality*, 4th edition, pp. 93-98.

† *Die göttliche Ordnung*, edition of 1775, vol. ii. pp. 241-284.

‡ See Newsholme, *Vital Statistics*, p. 62; and Bertillon, *Traité de Démographie*, p. 196.

tered in the State during the period 1850–90, there were
105.56 boys to every 100 girls.*

The discovery of this remarkable regularity in the pro-
portion of the two sexes at birth is an achievement of the
statistical method in its simplest form.   It never could
have been discovered by personal observation of indi-
vidual families.   Statistics has revealed the law: can it
furnish an explanation?

The first attempt to explain this phenomenon by statis-
tical investigation was made by Hofacker, a German, in
1828.   Two years later, but quite independently, Sadler,
an Englishman, investigated the same subject.   Both
arrived at the same conclusion ; namely, that " the pro-
portion in which the sexes are born is governed and regu-
lated by the difference in the ages of their parents, in
such manner that on the average, among the total of the
births, the sex of that parent shall exceed in number
whose age exceeds." †   The husband is usually older than
the wife, hence the excess of males among births.   They
found also — and later investigation bears them out — that
in the great majority of countries the excess of males
among illegitimate births is considerably less than among
the legitimate births.   In Massachusetts, in the period
1854–90, among the illegitimates whose sex was dis-
tinguished, there was an almost equal number of boys
and girls, the proportion of boys to girls being as 100.75
to 100.   The Hofacker-Sadler theory explained the smaller
excess of male births among illegitimates on the ground
that the parents of illegitimate children are, in general,
more nearly of the same age than are the parents of legit-
imate children.‡

This explanation of the excess of male births by refer-
ence to the relative ages of the parents has been ques-

* Total births, 1,632,294 : males, 836,686 ; females, 792,574; sex unknown,
3,034.

† Sadler, *Law of Population*, vol. ii., Book IV., chap. iii.

‡ *Ibid.*, pp. 337–339.

tioned, and certainly has not yet been sufficiently tested. Other theories have been advanced, one of the latest being that of Düsing,* who seeks an explanation of the phenomenon in biological causes. He thinks that the relative age of the parents does not exert so great an influence upon the proportion of the two sexes at birth as the relative distance of the two parents from the period of their greatest reproductive power. The probability of a boy birth is much greater when the mother is nearest that period, and the father is considerably removed from it. Most marriages occur when both parties are past this point; and, as the husband is considerably older than the wife, there results an excess of boys at birth.

Other factors also are discussed by Düsing. Thus a long delay between the first and second birth is likely to result in an excess of boys among the second births. Females are more sensitive to a deficiency or excess of subsistence than are males; and there is said to be a tendency to a large excess of male births in years of adversity, and *vice versa*. For the same reason, among the first-born, and among children born of mothers who are in advanced age,— since such mothers are not apt to provide good nourishment,— a large excess of boys is likely to occur.†

Another fact of importance in considering the problem of an excess of males at birth is that among the still-born the excess of males is much larger than among the living-born. This phenomenon has never been explained satisfactorily; and it seems to be connected with the higher infant mortality of males, which is itself unexplained. The still-born recorded in Massachusetts (1850–90) numbered 47,790, a number equal to 2.93 per cent. of the living-born. Of these, 3,918 (8.2 per cent.) were re-

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* Düsing, *Die Regulierung des Geschlechtsverhältnisses bei der Vermehrung der Menschen, Thiere und Pflanzen*, 1884.

† See Bertillon, *Traité de Démographie*, p. 197.

turned as sex unknown. Of the remaining there were 146.47 males to every 100 females.*

The following table shows the proportion of males born in Massachusetts to every 100 females for each five-year period since 1850. The still-born are included : —

TABLE I.

Periods.	Proportion of Males to 100 Females.	Periods.	Proportion of Males to 100 Females.
1851–55	. . . 106.84	1871–75	. . . 106.81
1856–60	. . . 106.26	1876–80	. . . 106.52
1861–65	. . . 107.73	1881–85	. . . 106.18
1866–70	. . . 106.53	1886–90	. . . 105.75

The table seems to suggest that in periods of great adversity the excess of males may be above the average. The most striking instance is that of the Civil War, for in that period the excess of males reached its highest point. During the last twenty years there has been a steady decline in the excess of males.

On the whole, it may be said that, while no theory attempting an explanation of the excess of boys at birth has been sufficiently tested and proved, the attempt to explain the phenomenon from biological causes is most promising. In this attempt investigators may get valuable clews, as they have done and are doing more and more, from data furnished by social statistics.

The Massachusetts Registration Report for the year 1854 was the first to distinguish illegitimate births. For the period since 1854 I have calculated the number of illegitimates to every 1,000 living births. This method is not the most scientific ; but it is the best available for the study of the illegitimate birth-rate for the whole period. After 1875 a more accurate method is possible, as comparison can then be instituted between the number of ille-

* Compare with Mayr, *Die Gesetzmässigkeit im Gesellschaftsleben*, pp. 249, 250.

gitimates and the unmarried females aged fifteen and above. The illegitimate birth-rates as thus computed show a general though irregular increase of illegitimacy in Massachusetts.* Part of this apparent increase is undoubtedly due to more complete registration. The entire increase, however, can hardly be explained in this way; for there has been a marked increase since 1880, and there is no reason to suppose that the returns were much more complete in 1890 than in 1880. It is probable that this increase in the illegitimate birth-rate is related to the diminution in the marriage-rate. Causes which tend to make marriage difficult exert an influence upon the number of illegitimates. While in Massachusetts the laws restricting marriage are not stringent, and the economic condition of the parties forms no legal objection to marriage, changed economic and social conditions have made marriage more difficult.† This accounts in part for the higher illegitimate birth-rate. It would be interesting to know whether illegitimacy is more prevalent in the urban than in the rural districts of Massachusetts, and the relative amount of illegitimacy among the foreign-born and the native population. Information on these points would doubtless throw more light upon the apparent increase of illegitimacy in late years. The registration reports, however, do not make the distinctions necessary for such an inquiry.

We proceed now to a consideration of the birth-rate as a whole. From data to be found in the Massachusetts censuses and in the United States censuses, we can compute the birth-rate according to three methods, of varying degrees of accuracy. The number of births may be compared: (1) with the total population; (2) with the total

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* See Table II., columns 6, 7, and 8.

† See a paper by the present writer on *The Marriage Rate in Massachusetts, 1850-90*, in *Publications of the American Statistical Association*, December, 1895.

TABLE II.

BIRTH-RATES IN MASSACHUSETTS, 1850-90.

(The figures in italics are the maxima and minima.)

1	2	3	4	5	6	7	8
YEARS.	Living births.	Rate per 1,000 total population.	Rate per 1,000 adult population.	Rate per 1,000 females aged 15-50.	Illegitimate births	Illegitimates to 10,000 living births.	Illegitimates per 1,000 unmarried females over 15.
1850	27,664	27.8	40.6	97.2			
1851	28,861	28.2	41.4	99.1			
1852	29,802	28.3	41.8	100.0			
1853	30,920	28.7	42.5	101.5			
1854	31,997	28.9	43.0	102.8	203	63.4	
1855	32,845	29.0	43.3	103.3	186	*56.6*	
1856	34,445	29.9	44.5	106.1	257	74.6	
1857	35,320	*30.1*	*44.7*	*106.8*	242	68.5	
1858	34,491	28.9	42.8	102.0	293	85.0	
1859	35,442	29.2	43.1	102.8	237	66.9	
1860	36,051	29.3	43.1	102.6	294	81.5	
1861	35,445	28.6	42.0	99.0	290	81.8	
1862	32,275	25.9	38.0	88.5	247	76.5	
1863	30,314	24.1	35.4	81.6	277	91.4	
1864	30,449	24.1	35.3	80.5	285	93.6	
1865	30,249	23.8	34.9	*78.6*	271	89.6	
1866	34,085	26.0	38.0	87.1	281	82.3	
1867	35,062	26.0	37.8	88.1	292	83.3	
1868	36,193	26.1	37.9	89.4	366	101.1	
1869	36,141	25.4	36.7	87.8	286	79.1	
1870	38,259	26.2	37.6	91.5	285	77.4	
1871	39,791	26.5	38.1	92.5	432	108.6	
1872	43,235	28.1	40.2	97.8	303	70.1	
1873	44,481	28.2	40.2	98.0	587	109.5	
1874	45,631	28.2	40.1	97.9	648	142.0	
1875	43,996	26.6	38.5	92.0	632	143.7	2.16
1876	42,149	25.1	35.4	86.8	713	169.2	2.37
1877	41,850	24.5	34.6	85.0	697	142.7	2.26
1878	41,238	23.8	33.5	82.3	640	155.2	*2.03*
1879	40,295	*22.9*	*32.2*	79.2	716	177.7	2.20
1880	44,217	24.8	34.7	85.7	778	176.0	2.34
1881	45,220	24.9	34.8	85.8	801	177.1	2.35
1882	45,670	24.7	34.4	84.9	865	189.4	2.48
1883	47,285	25.1	34.8	86.1	899	190.1	2.52
1884	48,615	25.3	35.1	86.8	894	183.9	2.45
1885	48,790	25.0	34.5	85.4	903	185.1	2.42
1886	50,788	25.3	34.8	86.2	1,034	203.6	2.69
1887	53,174	25.7	35.3	87.6	1,157	*217.6*	*2.92*
1888	54,893	25.8	35.3	87.9	1,059	192.9	2.60
1889	57,075	26.1	35.6	88.9	1,045	183.1	2.49
1890	57,777	25.8	35.0	87.6	1,206	208.7	2.80

adult population; and (3) with the total number of females of reproductive age. The rates determined by these three methods fluctuate in general in the same direction.*

Is the birth-rate diminishing in Massachusetts? Considering the general trend of the birth-rate for the last four decades, the answer must be in the affirmative. The birth-rate per 1,000 females aged fifteen to fifty years was 9.9 per cent. lower in 1890 than in 1850. The crude birth-rate was 7.2 per cent. lower, and the rate based upon the adult population was 13.8 per cent. lower, in 1890 than in 1850. This diminishing birth-rate in Massachusetts has been coincident with a diminishing marriage-rate.

Dr. Billings has pointed out that this tendency to a diminishing birth-rate is general in the United States as well as in Europe.† His conclusions, so far as the United States are concerned, are based upon the data contained in the tenth and eleventh censuses. These data are admittedly incomplete; but the assumption is made that the census returns are deficient in about the same degree for 1880 and for 1890. He calculates that the birth-rate in the United States was 4.27 less per 1,000 population in 1890 than in 1880, and that during this decade there was a decline in the birth-rate of all the States and Territories excepting Arizona, Colorado, Montana, and New Mexico.

There is some reason to doubt whether the decline in the birth-rate was as marked as Dr. Billings's figures would indicate. The following table is a comparison of his figures with those of the registration reports of four States. For Massachusetts, Rhode Island, and Michigan, where the births are registered by months, the computation has been based upon the births registered during the census year,— June 1 to May 31. For Vermont the rate, necessarily computed from the registered births for the

*See Table II., columns 3, 4, and 5.

† *The Diminishing Birth-rate*, in the *Forum*, June, 1893.

calendar year, has been compared with that from the enumerated births for the census year,—a much less trustworthy method.

TABLE III.

BIRTH-RATES FOR CENSUS YEARS.

|	Dr. Billings's Figures.			Registration Figures.		
	1880.	*1890.*	*Change.*	*1880.*	*1890.*	*Change*
Massachusetts. .	23.18	21.51	—1.67	24.00	26.18	+2.18
Rhode Island . .	23.88	23.38	—0.50	23.58	24.31	+0.73
Vermont . . .	21.71	18.51	—3.20	20.50	19.40	—1.10
Michigan . . .	27.64	24.80	—2.84	21.06	24.69	+3.63

As the registration figures are probably more accurate than those of the census, and as the results are quite different, it seems justifiable to question the census returns, or at least to suspend judgment until the greater trustworthiness of the census results is clearly shown. In three of the States the registration returns show a higher birth-rate in 1890 than in 1880, while in Vermont the decrease is considerably less than Dr. Billings's figures would indicate.

The following table gives the crude birth-rate of Massachusetts and several foreign countries for the last four quinquennial periods: —

TABLE IV.

	1871-75.	*1876-80.*	*1881-85.*	*1886-90.*
Massachusetts	27.5	24.2	24.4	25.7
England and Wales . .	35.5	35.4	33.5	31.5
Scotland	35.0	34.8	33.3	31.4
Ireland	27.2	25.8	23.9	22.8
Denmark	30.8	32.0	32.5	31.6
Norway	30.2	31.5	30.9	30.4
Sweden	30.7	30.3	29.4	29.0
Austria	39.5	38.8	38.3	37.7
Switzerland	30.1	31.3	28.7	27.4
Belgium	32.2	31.9	30.7	26.3
France	25.5	25.9	24.7	23.0
Prussia	38.9	39.2	37.4	37.3
Italy	36.7	36.8	37.9	37.6

Birth Rates per 1[...]

Marriage Rates per [...]

Birth Rates per 1[...]

Death Rates per 1[...]
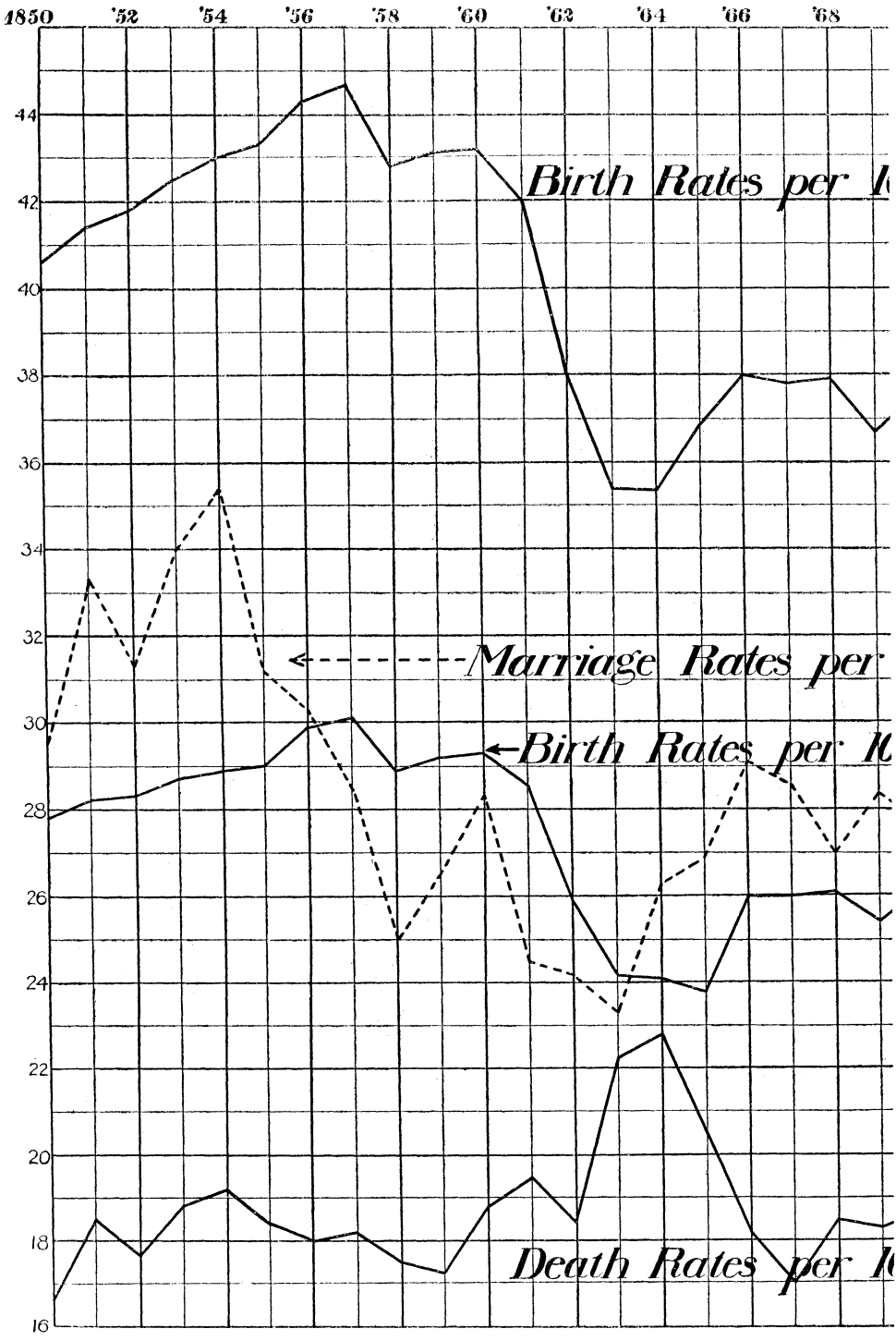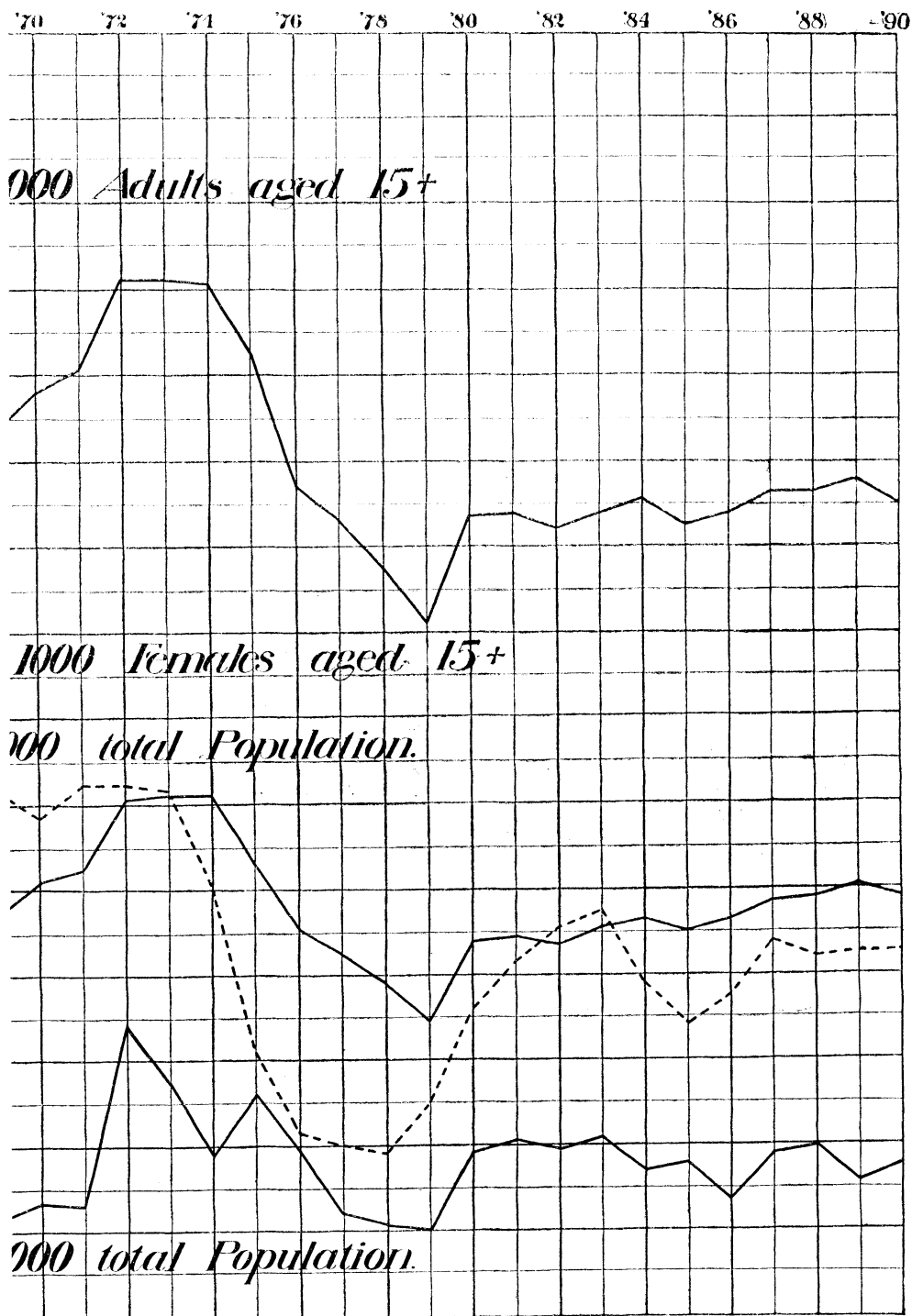
Excepting Denmark, Norway, and Italy, the birth-rate in every instance was higher in the first period than in the last.*

There is no ground for questioning the general statement that the birth-rate in the United States, as a whole, and in the separate States and Territories, is diminishing. This phenomenon is general: it appears in Europe as well.

We turn now to some questions on relations of the birth-rate to other phenomena; and, first, to the connection between birth-rate and marriage-rate. The attached chart represents the birth-rates based on the total adult population aged 15+, and the marriage-rates based on the adult female population.† At first sight there seems to be little resemblance in the two lines. It must be remembered, however, that changes in the marriage-rate could only influence the birth-rate after the lapse of a year or more. Hence we should expect that, if they vary together, the changes in birth-rate would follow those of the marriage-rate. The curves present a number of instances where a depression or elevation in the marriage-rate is followed in one, two, or three years, by a similar movement in the birth-rate. The points on the marriage curve indicated for the years 1854, 1863, 1873, 1878, 1883, and 1887, may be taken as illustrations. There are only four instances where a reversal of a downward or upward movement in the marriage curve is reflected in the birth curve for the same year: in 1858, 1860, 1866, and 1885. It seems to be the general rule in Massachusetts that changes in the birth-rate conform roughly to those in the marriage-rate of a year or two earlier.

An inspection of the chart indicates at once some degree

* The rates for the foreign countries are computed from statistics in the *Registrar-general's Report* for 1890, pp. lxiv-lxxiv.

† The figures for the birth-rates are given in Table II., column 4; those for the marriage-rates, in the article in the *Publications of the American Statistical Association*, December, 1895.

of connection between birth-rate and prosperity. Witness the rise in the birth-rates of the years 1850–57, and again of the years 1869–73, and the fall after the crises of 1857 and 1873. A connection between marriage-rate and prosperity appears also from the chart, and was pointed out in the article on marriage-rate already referred to; and this, since there is a correspondence of birth-rates with marriage-rates, serves to establish a relation between birth-rates and prosperity. But prosperity and adversity may influence the birth-rate in another way than through its effect on the number of marriages. A sudden increase in prosperity undoubtedly influences the birth-rate; but continued prosperity may not do so. Prudence and foresight are important factors among those bearing on fecundity; and in two different populations the marriage-rate may be the same, and the birth-rate yet very different. While temporary changes in prosperity affect the birth-rate, it cannot be said that, over a long term of years, advance in welfare will be reflected in an increased birth-rate. The reverse is often true.

Next we may inquire as to the relation between birth-rate and density of population. The marriage-rate is higher in the densely populated or urban districts than in those sparsely inhabited. Does the same relation hold for the birth-rate? To determine this point, a more thorough analysis has been made than in the study of the marriage-rate. Each of the 347 towns and cities of Massachusetts in 1885 has been considered separately, and they have then been combined into groups. To eliminate as far as possible accidental disturbances, the average number of births in each town and city for the nine-year period 1881–89 has been taken in computing their respective birth-rates. The foreign-born population is a complicating element in Massachusetts; and, as that population lives mainly in the urban and more densely settled districts, it is necessary to distinguish the birth-rates of the native and

the foreign born.   Otherwise a higher birth-rate in the thickly settled districts might simply mean that the foreign-born element was stronger in those districts, for the

TABLE V.

DENSITY OF POPULATION AND BIRTH-RATE IN MASSACHUSETTS, 1885.

1	2	BIRTHS PER 1,000 MAR-RIED WOMEN.			DEATHS OF CHIL-DREN AGED 0-1 YEAR.		8	9
		3	4	5	6	7		
Population per square mile.	Number of towns in group.	Total.	Native.	Foreign.	Per 1,000 total deaths.*	Per 1,000 living births.	Number of surviv-ors at one year per 100 married women, all ages.	Percentage of in-crease or decrease in population,1875-85.
0-24	39	59.7	57.1	64.5	97.4	106.6	5.34	—13.9
25-49	64	62.9	58.2	89.1	103.7	121.5	5.53	—13.3
50-99	103	74.1	61.5	117.9	140.3	126.6	6.45	+2.2
100-199	44	83.0	67.2	119.0	148.9	122.5	7.28	+6.3
200-499	52	106.3	87.6	133.2	193.1	135.3	9.19	+15.9
500-999	22	106.0	84.1	146.3	194.3	136.3	9.13	+37.0
1,000-4,999	19	120.0	86.0	153.0	249.7	175.3	9.91	+29.5
5,000+	4	124.0	99.0	139.0	229.9	185.8	10.10	+17.0

foreign-born population is more prolific than the native. In Table V. the towns and cities of Massachusetts have been divided according to density into eight groups.   It shows an increased birth-rate as the density of population increases.   Not only is this true of the general birth-rate; it is true also, when comparison is made separately of the native and foreign-born birth-rates.   In the nineteen towns and cities with a density from 1,000 to 5,000 persons per

*The figures in this column are based on the annual average of the total deaths and of the deaths of children under one year of age, during the period 1881-89.

square mile the birth-rate among foreign-born women is 2.37 times as high as in the thirty-nine towns with an average density of less than twenty-five persons per square mile. While the connection between increased birth-rate and increased density of population is most marked among the foreign-born, it appears also among the native-born.

A partial explanation of this striking coincidence of high birth-rate with density of population may perhaps be found in the fact that the streams of migration flow towards the urban districts. Not only do the vast majority of the foreign immigrants prefer city to country life, but the rural population of Massachusetts is flocking to the urban districts. Counting as urban the villages and cities having 4,000 or more inhabitants in 1890, Massachusetts showed a considerable decrease in her rural population during the decade 1880–90. The total population increased 25.57 per cent., the urban population increased 50.54 per cent., and the rural population decreased 14.85 per cent.,— in absolute numbers 66,956. Six of the fourteen counties showed a loss of rural inhabitants. As a rule, it is the young, strong, enterprising, and ambitious who migrate. The best vitality of the country goes to the large towns and cities.

It is interesting to compare the increase in the total population of the towns and cities of Massachusetts grouped according to density. The two groups with the lowest density show an actual decrease in population of more than 13 per cent.* The next four groups show an increase of population, progressively greater as the density increases. In the two groups of greatest density, however, the percentage of increase in population is lower than for the sixth group, which is probably to be explained by the fact that the great cities had attained more complete growth in 1875 than had the towns, largely suburban, with a density of from 500 to 1,000.

*See Table V., column 9.

No picture of the natural increase of a population can be formed without taking both deaths and births into account. The facts already stated as to the birth-rate in Massachusetts suggest many questions as to the death-rate. Has the death-rate decreased with the birth and marriage rates? Is there any close connection between births and deaths? Does density of population influence the birth-rate by affecting infant mortality? Light may be thrown on some of these questions from statistics which have been gathered in Massachusetts. It is not my intention, however, to attempt any detailed discussion of deaths and death-rates : I wish simply to point out the results of one or two lines of investigation.

The crude death-rate is the ratio between the persons dying and the living population among whom the deaths occur. The difference between the crude birth-rate and the crude death-rate of a population expresses the natural movement of the population. Throughout the period 1850–90 the birth-rate of Massachusetts has been higher than the death-rate. In the year 1864, however, the rates approached very near each other. The excess of births over deaths in proportion to the total population was greatest in the ten-year period just prior to the Civil War, and in the years just after the close of the war, and prior to the long depression of 1873–79. In the last decade both the birth and death rates have been very stable, with a slight tendency to an increase in the birth-rate and de-crease in the death-rate. The natural increase in the pop-ulation at the present time is very slow. There are about 26 births and 20 deaths annually to every 1,000 popula-tion ; that is, there are added to the living population each year through natural increase only about 6 persons to every 1,000. This is a somewhat slower increase than most countries show. The following table presents the excess of births over deaths to every 1,000 population of Massachusetts and various foreign countries.

TABLE VI.

NATURAL INCREASE OF POPULATION IN MASSACHUSETTS AND
SEVERAL FOREIGN COUNTRIES.

	1871-75.	*1876-80.*	*1881-85.*	*1886-90.*
Massachusetts	6.7	5.4	4.6	6.3
England and Wales . .	13.5	14.6	14.1	12.6
Scotland	12.3	14.2	13.7	12.6
Ireland	9.5	7.1	5.9	4.9
Denmark	11.3	12.6	14.0	12.8
Norway	12.7	15.0	13.9	13.6
Sweden	12.4	12.0	11.9	13.2
Austria	6.8	8.3	8.1	8.8
Switzerland	6.3	8.2	7.4	7.0
Belgium	8.9	10.2	10.1	9.2
France	.6	3.5	2.5	1.0
Russia	11.2	13.8	12.0	13.3
Italy	6.4	7.4	10.6	10.3

The table shows that the natural rate of increase in
Massachusetts is about the same as that in Ireland, Aus-
tria, and Switzerland. In France alone, where population
is virtually stationary, is the natural increase markedly
less than in Massachusetts.

The subject of infant mortality is of special importance
in connection with a study of births. Table V. (columns
6 and 7) shows the relation between infant mortality and
density of population in Massachusetts for the year 1885.
There seems to be a remarkably close connection between
infant mortality and density of population. In the sparsely
settled districts there are fewer births relatively to the
married women than in the more densely populated dis-
tricts. But, on the other hand, fewer infants, relatively
to the total number born, die before reaching the age of
one year. Whether we compare the deaths under one
year with the total living births or with the total number
of deaths at all ages, the infant mortality is greater in the
urban than in the rural districts. A high infant mortality
is generally coincident with a high birth-rate; and the
high birth-rate is generally assumed to be the cause of the

high infant mortality. This is doubtless true to a great extent; but may not a high infant mortality affect the birth-rate? The death of a child before it has reached the age of one year not only shortens the interval between child-bearing, but leaves a vacancy to be filled by another birth.

A fact of importance is brought out in column 8 of Table V. In those communities where infant mortality is greatest, the number who survive at the age of one, as compared with the married women, is greatest, and *vice versa*. The more children who die before attaining the age of one year, the more children are born, not only in an equal proportion, but in a greater; and, the smaller the infant mortality, the smaller is the fecundity of women. The explanation of this phenomenon is not difficult. In families where foresight and prudence rule there are likely to be fewer children born than in families lacking these qualities. Infant mortality, so far as it is independent of man's action, will affect both families alike. Looking no farther, we should expect a larger excess of children in the families exercising least foresight. It is true that the parents with little foresight are apt to give less careful attention to their children than the other parents, and their children hence would show a somewhat larger infant mortality. But the figures indicate that this is not sufficient to offset the difference in fecundity of the two classes of parents. Foresight and prudence seem to exercise a more powerful influence in restricting fecundity than in reducing infant mortality. In other words, the causes influencing infant mortality seem to lie more largely outside of man than do the causes influencing fecundity.[*]

In conclusion, a relation between conceptions and deaths may be mentioned, to which, so far as I am aware, attention has not hitherto been called. Considering the births

[*] Compare Tallqvist, *La Tendance à une Moindre Fécondité des Mariages*, pp. 59, 60.

of a given month to be the result of conceptions nine months previous, I have compared the conception-rate with the crude death-rate in Massachusetts for the twelve years, 1880–91. A study of the rates thus compared shows that, in general, a high death-rate is coincident with a low conception-rate. In those months when the equation of life is low — that is, when the surplus of vitality is small — there are many deaths and few conceptions. On the other hand, when the equation of life is high, as in the autumn and early spring, there are relatively few deaths and many conceptions. In 99 of the 144 months examined, or over two-thirds, when the death-rate was above the general average, the conception-rate was below the average, and *vice versa*.

The main results of the foregoing study may be summarized as follows : —

1. The excess of males born in Massachusetts was greater during the Civil War than in any other of the eight quinquennial periods; and during the last twenty years it has steadily decreased.

2. Illegitimacy has gradually increased ; and at present about 1 child in 50 is illegitimate. This may be connected with the slowly declining marriage-rate.

3. The average annual number of births to 100 women between fifteen and fifty is about 9 instead of about 10, as it was forty years ago.

4. There is some reason for doubting the accuracy of the census figures indicating a general and very rapid decline of the birth-rate in the United States between 1880 and 1890.

5. The birth-rates have fluctuated in rough conformity with the fluctuations of the marriage-rate a year or more before.

6. The denser the population, the higher the birth-rate, and this both among the native and the foreign born population.

7. The denser the population, up to 1,000 to a square mile, the more rapid was the increase between 1875 and 1885 ; while the 103 towns having less than 50 people to a square mile as a whole lost one-seventh of their population.

8. The denser the population, the greater the infant mortality. But the birth-rate increased with the density of population faster than the infant mortality.

9. In months when deaths are many, conceptions tend to be few, and *vice versa*.

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